features of the East African coastlands—their labyrinth of creeks and backwaters, their miles of waterless scrub, or groves of *Hyphæne* palms, perhaps the most typical tree of a large part of their area. In the more northern districts traversed, on the borders of the Galla territories south of the Jub River, Mr. FitzGerald was actually breaking new ground, and the result of his journeys has been to modify considerably our ideas of the general character of the country, by showing that the vegetation is in parts of the interior much more luxuriant than has been generally supposed. Throughout his residence in the country he was in close touch with the native inhabitants, for whom he shows a genuine liking, and of whose life and customs many interesting details are given.

It is, however, in the treatment of the agricultural capabilities of the country that the chief value of the book will be found to exist. During the whole of his travels, the author devoted his constant attention to this subject, so that the information collected was unusually varied and complete, and the picture presented of the various aspects of life in the African "shambas" (plantations) is full of interest. The general reader may, perhaps, find the mass of details on agricultural subjects hardly to his taste; but to all who require a trustworthy guide to the capabilities of British East Africa in such matters, the book will prove of sterling value. A special weight attaches to Mr. FitzGerald's views from his wide experience of agriculture as carried out in Southern India, and he has done good service in calling attention to what he considers the great possibilities which lie before British enterprise in this direction in the East African coastlands. Much of the country is, in his opinion, eminently adapted for the growth of cotton and coco-nuts, while other products, such as fibre-plants and india-rubber, would also repay attention. Much apposite information regarding all these, drawn from sources not widely accessible, is printed in the form of appendices.

In the second part of the book, Mr. FitzGerald enlarges upon his report, made to the Directors of the East Africa Company in 1892, on the agricultural capabilities of Zanzibar and Pemba Islands. He treats exhaustively of the clove cultivation there carried on, describing minutely the requirements of the clove tree, the present methods employed in its culture, and various improvements which should be introduced. He also treats of other products to which attention should be paid, in order that the prosperity of the islands may not depend, as it does at present, on one crop alone. In the case of Zanzibar the ground has, it is true, been already covered to some extent by Dr. Baumann's useful monograph, but it is valuable to have also a professed agriculturist's views on the subject, which the German traveller approached rather from the standpoint of a scientific geographer. A point of special interest at the present time, when the slavery question seems to await its final solution, is the discussion of the sources of labour supply, into which Mr. FitzGerald enters fully. He holds that the introduction of Indian coolies will afford the best hope of a satisfactory solution of the problem.

A useful feature in the book is the lavish supply of maps (compiled by Mr. Reeves, of the Royal Geographical Society), in which the whole of the author's routes can be followed, and which contain material not hitherto published. The index—also a point of special importance in a work intended, like the present, to be used for reference—is particularly full and well arranged.

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## OUR BOOK SHELF.

*Notes on Observations.* By Sydney Lupton, M.A. Pp. ix + 124. (London: Macmillan and Co., 1898.)

THE sub-title of this book describes the contents as "an outline of the methods used for determining the meaning and value of quantitative observations and experiments in physics and chemistry, and for reducing the results obtained." It is very important that students of science should be logical in their arguments and sound in their conclusions; and Mr. Lupton's concise description of the methods which must be followed before a scientific law or any general proposition can be established conduce to this end. The opening chapters of the book remind us of Huxley's inspiring little "Introductory" Science Primer. After these more or less metaphysical, but distinctly serviceable, statements as to ideas, premisses, and laws, come short chapters on units, averages, interpolation, the law of error, the method of least squares, the expression of results by graphical and by empirical methods, and many other subjects of interest to all who are engaged in quantitative physical and chemical experimentation. The treatment is but brief in most cases, and questions involving higher mathematics are not introduced. Sufficient is said, however, to show students how to apply to his own results the methods described; and for those who desire to go into the subjects more thoroughly, a list of references to standard works is appended to each chapter.

The book should find a place in the library of every physical and chemical laboratory, and all students of the laws and phenomena of nature should make themselves familiar with the principles described; for they will thereby learn the methods of sound reasoning, and be instructed in the art of computation for the purposes of science.

*Prospecting for Minerals: a Practical Handbook for Prospectors, Explorers, Settlers, and all interested in the Opening-up and Development of New Lands.* By S. Herbert Cox. Pp. xi + 239. With illustrations. (London: Charles Griffin and Co., Ltd., 1898.)

THIS little work forms the first volume of a new series of handbooks to be edited by Prof. Grenville Cole, and issued under the title of "The New Land Series." Although it can hardly be said that the title of the series is very happily chosen, it will be immediately admitted that the object of the series is distinctly good. The explorer or the settler in any new country needs, in most cases, some instruction as to the best means of discovering and developing its resources. Of all pioneers of civilisation, the mineral prospector is the most likely nowadays to lead the way; and the first volume of the series is, therefore, appropriately devoted to the subject of prospecting. The preparation of the work has been entrusted to Mr. Herbert Cox, a well-known mining engineer in London, who has in his day travelled widely and seen much of mines and minerals. Those who know the character of his professional work will feel no doubt as to his ability to lead the prospector in the way he should go; and an examination of the volume shows that its value is beyond dispute. Mr. Cox has furnished the prospector with a portable guide, which, while essentially practical, contains sufficient geology and mineralogy to explain the scientific principles on which the search for minerals should be based. The rough-and-ready prospector may probably think that the science is too much in evidence, and may grow impatient as he turns over pages about such things as "anhydrous silicates of lime

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and alumina and their crystallographic allies." But the explorer should clearly understand that, notwithstanding occasional accidents, the most trustworthy results in the search for minerals will, in the long run, be reached by that man who brings to bear upon his work the widest range of scientific knowledge.

*The Process of Creation Discovered; or, the Self-evolution of the Earth and Universe by Natural Causes.* By James Dunbar. Pp. viii + 290. (London: Watts and Co., 1898.)

TO review this book would be to give prominence to a volume every page of which exemplifies the dangerous character of a little knowledge. We will merely remark that the author finds himself at variance with very many physical facts and theories, disbelieves the results of spectroscopic analysis applied to celestial bodies, and regards the solar photosphere as a deep ocean of water. According to his theory of inorganic evolution, "the only elements employed or necessary in the formation of the sun, solar system, and universe are those composing atmospheric air and water." Students of science may be left to form their own opinion upon a book containing an assertion of this kind.

*Domestic Science Readers.* Book vii. By Vincent T. Murché. Pp. 298. (London: Macmillan and Co., 1898.)

THE subject of domestic economy is taught in the various standards of our elementary schools; and this book is adapted to supply girls in the highest standards with the information which the Education Department expects them to possess. The laws of health, infant management, common ailments and their remedies, common accidents, infectious diseases, and management of the sick-room are the subjects dealt with in the six parts of the book, and they are treated in a very clear and instructive manner. Mr. Murché knows how to interest the young readers for whom he writes, and this little school book will doubtless be as successful as the others of which he is the author. Moreover, the pupils who read the book will receive a large amount of sensible advice which will give them a sound understanding of the laws of health, and thus be of service to them and to future generations.

*A Course in Mechanical Drawing.* By John S. Reid. Pp. 128. (New York: John Wiley and Sons. London: Chapman and Hall, 1898.)

TEACHERS of the elements of mechanical drawing to students in marine, electrical, railway, and mechanical engineering will find that this book contains a concise statement of the essential principles of the subject. In the five chapters, the author deals with drawing instruments, geometrical drawing, or the use of the instruments, conventional methods of drawing used by draughtsmen, lettering and figuring, and orthographic projection. The author is instructor in mechanical drawing and designing in Sibley College, Cornell University, and his experience has enabled him to produce a useful work.

*Flower Favourites, their Legends, Symbolism and Significance.* By Lizzie Deas. Pp. viii + 229. (London: George Allen, 1898.)

MANY pretty stories concerning common flowers have been collected from folk-lore and classic myths by the author, and are presented here in an attractive setting. The nursery traditions and love legends referring to flowers and flower-names are numerous and interesting enough, but very little attention is devoted to the subject of "plants and flowers in their widest relationships" referred to in the preface.

## LETTER TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

### Röntgen Rays and Ordinary Light.

I QUITE agree with the physical principles in Lord Rayleigh's article on "Röntgen Rays and Ordinary Light" in NATURE of April 28, and think that the difference between us is one of terminology. I am accustomed to restrict the word wave to disturbances in which the harmonic character is well developed, and not to use it in physics in the sense in which it is used in the phrase "a wave of enthusiasm." It would never have occurred to me to speak of a disturbance localised in a thin shell as a wave of short wave-length. I should speak of it as a pulse, and though such pulses can of course be resolved by Fourier's theorem into trains of waves, yet it seems to me that when a simple pulse is so resolved (except for some special purpose), there is a loss of clearness both in expression and conception analogous to that which would occur if we regarded a straight line as an aggregate of harmonic curves.

The term pulse has the advantage that it suggests the fundamental property of the Röntgen rays, that their action on matter in their path is an *impulsive* action, *i.e.* that the time constant of the disturbance (the time taken by the pulse to pass over a point) is small compared with the time constant of the system in their path (the time of vibration of the molecules).

I am not aware that I have ever regarded these pulses as possessing any physical property which would be inconsistent with the physical properties of the constituents into which they can be resolved by Fourier's theorem. Personally I should expect that if a train of waves of wave-length $\lambda$ were refracted, a pulse of thickness $\lambda$ would be refracted too, and if the thickness of these pulses were of the order of the wave-length of ordinary light, that the Röntgen rays would be like ordinary light.

I believe the Röntgen rays to be pulses rather than waves of small wave-length, not because I think the properties of the latter would be different from those of Röntgen rays as far as we know them, but because electromagnetic theory shows that pulses, and not short waves, are produced by the impact of kathode rays.

J. J. THOMSON.

Cambridge, April 30.

## SLEEP, AND THE THEORIES OF ITS CAUSE.

THE theory of the origin of sleep which has gained the widest credence is the one that attributes it to anæmia of the brain. It has been shown by Mosso, and many others, that in men with defects of the cranial wall the volume of the brain decreases during sleep. At the same time, the volume of any limb increases as the peripheral parts of the body become turgid with blood. In dogs, the brain has been exposed, and the cortex of that organ has been observed to become anæmic during sleep. It is a matter of ordinary observation that in infants, during sleep, the volume of the brain becomes less, since the fontanelle is found to sink in. It has been supposed, but without sufficient evidence to justify the supposition, that this anæmia of the brain is the cause and not the sequence of sleep. The idea behind this supposition has been that, as the day draws to an end, the circulatory mechanism becomes fatigued, the vasomotor centre exhausted, the tone of the blood vessels deficient, and the energy of the heart diminished, and thus is the circulation to the cerebral arteries lessened. By means of a simple and accurate instrument (the Hill-Barnard sphygmometer), with which the pressure in the arteries of man can be easily reckoned, it has been recently determined that the arterial pressure falls just as greatly during bodily rest as during sleep. The ordinary pressure of the blood in the arteries of young and healthy men averages 110–120 mm. of mercury. In sleep, the pressure may sink to 95–100

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